



Forest
Service

Southwestern Region
Forest Health
Arizona Zone Office

2500 S. Pine Knoll Drive
Flagstaff, AZ 86001-6381
FAX (928) 556-2130
Voice (928) 556-2073

File Code: 3420
Route To: (2300), (2400)

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Subject: Pinaleño Ecosystem Restoration Project

To: District Ranger, Safford RD

On July 16th, 2008, I met with Craig Wilcox, Silviculturist, to observe the presence and impacts of forest insects and disease in select stands of the Pinaleño Ecosystem Restoration Project (PERP) area. We were joined by Debby Kriegel, Forest Landscape Architect, Anne Casey, Wildlife Biologist, and Ann Lynch, Research Entomologist with Rocky Mountain Research Station. The primary objectives of PERP are to protect occupied Mount Graham red squirrel habitat, reduce the potential for wildfire and insect and disease outbreaks, and manage for long-term sustainability of red squirrel habitat. Current fuel loads and stand densities are much greater than historic forest conditions. The ecological implications of these shifts have led to increased susceptibility to insect outbreaks and stand-replacing fires, especially in spruce and fir, over the past 10+ years. We visited PERP units to discuss forest restoration treatments and recreation sites (both developed and dispersed) within the PERP area to talk about vegetation management plans. We observed symptoms and signs of insects and disease including root disease, dwarf mistletoe, defoliating insects, and bark beetles. Our stops included forest restoration treatment unit 322, Soldier Creek Campground (CG), and Peter's Flat dispersed camping area.

Forest Restoration Units

We viewed PERP forest restoration Unit 322 and other units that Craig and Ann had observed with recent blowdown and/or mortality. Similar to much of the PERP area, these units are in high-density mixed-conifer forests in which late-successional tree species are now common due to fire suppression. Although the types and impacts of forest insects and diseases varied upon location, southwestern white pine mortality caused by mountain pine beetle was observed throughout the project area. Armillaria root disease, caused by *Armillaria ostoyae*, was associated with recent spruce mortality and was suspected as a causal agent in the death of subalpine fir regeneration. Root disease activity is likely to increase in stands converting to later succession tree species, as spruce and subalpine fir are more susceptible to root disease fungi. Armillaria and other root diseases (e.g. *Heterobasidion annosum*) can act as opportunists, infecting trees stressed by other factors, under endemic conditions but become more virulent when fungal populations increase in dead and dying trees and residual trees are stressed by other damaging agentsⁱ. In this case, many sites across the project area have experienced bark beetle caused mortalityⁱⁱ or have been repeatedly defoliated by spruce aphid over the past decadeⁱⁱⁱ. The combination of changes in forest composition to the more root disease susceptible spruce



and fir, and defoliation by the non-native spruce aphid, has plausibly increased root disease activity on the more mesic sites across the project area.

At one site there was a large swath of white fir that had recently fallen like dominos, all in the same direction, at the edge of a meadow. Although these trees were fairly large, they were not very old and their root systems too shallow to hold up in a severe wind. Schweinitzii root and butt rot was observed in a couple of recently fallen Douglas-fir.

The proposed forest restoration treatments are a combination of variable density thinning, thinning from below, and group selection. There is an 18-inch maximum cut diameter limit and a minimum 150 square feet per acre basal area (BA) stand stocking level target. Early seral species will be favored. Variable thinning treatments will be applied to create forest stands that are diverse in structure and stocking level, in which some groups within the matrix are thinned to a wide spacing (80 BA), and some groups have close spacing or not thinned at all. Heavily thinned groups would be located near aspen clones, or ponderosa pine and old growth Douglas-fir patches to enhance the growth of more seral species or to regenerate these components.

Soldier Creek CG

This campground is located in a mixed conifer forest composed mostly of Engelmann spruce, southwestern white pine, Douglas-fir, aspen, and ponderosa pine. Several dead spruce and southwestern white pines were observed. Spruce mortality was attributed to a combination of causal agents including spruce aphid, dwarf mistletoe infection, and/or armillaria root disease, the same agents observed in many residual spruce trees with thin crowns and branch mortality (Figures 1 and 2). Southwestern white pine mortality was attributed to mountain pine beetle. Southwestern white pines less than 12 inches in diameter at breast height (DBH) were relatively healthy except for death of one-year needles by needlecast fungi. Although older mature aspen are present, most aspen in the campground are fairly young and vigorous. We did not observe any damaging insect or disease in ponderosa pine.

Douglas fir dwarf mistletoe (*Arceuthobium douglasii*) is dispersed throughout the site; ranging from groups of severely infected Douglas fir trees to groups showing little to no infection. Douglas fir dwarf mistletoe causes the host to form large witches' brooms composed of very flammable fine branching that add to the high fuel loads found in the project area. Mortality of dwarf mistletoe infected Douglas fir is likely related to a higher incidence of Douglas-fir beetle



Figure 1 Dead and dying spruce in Soldier Creek CG.



Figure 2 Armillaria root disease fruiting bodies and decay from an old spruce stump.

(*Dendroctonus pseudotsugae*). Based on a recent study on the San Francisco Peaks and elsewhere in Arizona, Douglas-fir beetle appears to focus its initial attacks on trees infected by dwarf mistletoe and root disease (e.g., *Armillaria* spp.), which are more common in higher elevation forests (McMillin and Fairweather, unpublished data). We observed armillaria root disease during our walk through; however, it was located on dead spruce trees that had been infected with dwarf mistletoe. There was no evidence of recent Douglas-fir mortality. Although Douglas-fir dwarf mistletoe is present on the site, the mixed species nature of the stand will limit the disease from becoming a severe problem in this stand.

Soldier Creek CG will benefit from a vegetation management plan and implementation that can improve the health of residual trees by decreasing tree density and selecting for trees more resistant to decay. We discussed the poor health of spruce in this campground and the value of directing the stand to early successional species, particularly ponderosa pine. Ponderosa pine regeneration is preferred in the immediate camping sites. Although aspen is also likely to increase following thinning treatments, it is sensitive to compaction and camper injuries and would be a better species to locate away from the immediate camping units.

Peter's Flat Dispersed Area

There are several dispersed walk-in camping units located in a very dense mixed conifer forest with lots of large dead and dying conifers present. Stem decay, or internal heartwood decay, is evident in some of the living trees. Since fire pits are present, the older more decadent trees that pose a hazard to campers in these areas could be targeted for removal during thinning treatments.

Recommendations

The proposed forest restoration thinning treatments will reduce tree densities, decrease fuels, and promote early seral species including Douglas-fir, ponderosa pine and aspen. These treatments should reduce the overall susceptibility of stands to bark beetle attack, decrease root disease impacts, lower dwarf mistletoe inoculum, and improve overall tree vigor. We recommend careful monitoring of Douglas-fir beetle and spruce beetle populations associated with this fuel reduction project. Our staff can assist with this monitoring through inspection of logs and slash, ground surveys, and aerial detection surveys. A chemical anti-aggregation pheromone, MCH, could be used to prevent attacks within the project area if beetle populations were to increase. This treatment is typically targeted to high value sites such as campgrounds, administrative sites and critical wildlife habitat, i.e. red squirrel midden sites.

We applaud the District for developing recreation site vegetation management plans. The plans are an important first step to insuring a healthy and safe forest in developed recreation sites. Over the last 100 years, forests have developed into more climax tree species, which has increased the incidence of stem and root decay as well as insect activity. *Armillaria* and other root decay fungi quickly invade the root systems of infected trees when they are cut or killed. Although root disease fungi can infect by means of windborne spores on fresh stumps or basal wounds, they more commonly infect via root contacts. The pathogens survive for decades as saprophytes on woody tissues of stumps and snags, which act as a food base. Spread occurs

when healthy roots contact decayed roots, or, in the case of armillaria root disease, through root-like structures (rhizomorphs) that grow through the soil for short distances and penetrate root bark.

Root diseases typically persist on a site for decades by surviving in roots of stumps or snags and on infected roots of live trees. They slowly spread outward in all directions, resulting in a slowly enlarging group of dying and dead trees. By targeting the removal of these susceptible trees and retention of the more decay resistant species, a safer campground is created. Root disease inoculum can be further reduced in campgrounds by removing stumps during any planned campground construction.

If you have any questions about this report, please contact me at mfairweather@aspect1.net or by phone at (928) 556-2075.

/s/ Mary Lou Fairweather
MARY LOU FAIRWEATHER
Forest Pathologist, Forest Health, Arizona
Zone

cc: Craig P Wilcox
Lisa Angle
John Anhold
Debra Allen-Reid
Alan Quan

ⁱ Shaw C.G., III, Kile G.A. 1991. Armillaria root disease. Agriculture Handbook 691 Washington, DC: U.S. Department of Agriculture, Forest Service. 233p.

ⁱⁱ Wilson J.L., Fitzgibbon R., Dudley S. 1999. Evaluation of a spruce and western balsam bark beetle outbreak on Mt. Graham, Safford Ranger District, Coronado N.F. USDA Forest Service, Southwestern Region, Forestry and Forest Health, Arizona Zone, Flagstaff, AZ. In house evaluation. 22p.

ⁱⁱⁱ Lynch A.M. 2004. Fate and characteristics of Picea damaged by Elatobium abietinum (Walker) (Homoptera: Aphididae) in the White Mountains of Arizona. Western North American Naturalist. 7-17.